ISC Class 12 Chemistry Question Paper Solution 2018

CHEMISTRY THEORY (PAPER 1)

Question 1

(a) Fill in the blanks by choosing the appropriate word/words from those given in the brackets: **[4×1]**

(square pyramidal, electrical, 74, 26, sp^3d^2, sp^3d, chemical, 68, 32, tetrahedral, yellow, white, iodoform, Lucas)

(i) A Galvanic cell converts _____ energy into _____ energy.

(ii) The percentage of unoccupied spaces in bcc and fcc arrangements are _____ and _____ respectively.

(iii) Propan-2-ol on reaction with iodine and sodium hydroxide gives _____ precipitate and the reaction is called _____test.

(iv) The geometry of $XeOF_4$ molecule is _____ and the hybridisation of xenon atom in the molecule is _____.

(b) Complete the following statements by selecting the **correct alternative from** the choices given: **[4×1]**

(i) During the course of an S_N1 reaction, the intermediate species formed is:

(1) a carbocation

(2) a free radical

(3) a carbanion

(4) an intermediate complex

(ii) Purification of aluminium by electrolytic refining is called:

(1) Serpeck's process

(2) Hoope's process

(3) Hall's process

(4) Baeyer's process

(iii) An aqueous solution of urea freezes at $-0{\cdot}186^oC$, K_f for water = $1{\cdot}86$ K kg mol^{-1}, K_b for water = $0{\cdot}512$ K kg mol^{-1}. The boiling point of urea solution will be:

(1) 373·065 K

(2) 373·186 K

(3) 373·512 K

(4) 373·0512 K

(iv) In the dehydration of alcohols to alkenes by heating with concentrated sulphuric acid, the initiation step is:

(1) formation of carbocation

(2) formation of an ester

(3) protonation of alcohol molecule

(4) elimination of water

(c) Match the following: **[4×1]**

(i)	Rate constant	(a)	Dialysis
(ii)	Biodegradable polymer	(b)	Glycine
(iii)	Zwitter ion	(c)	Arrhenius equation
(iv)	Purification of colloids	(d)	PHBV

(d) Answer the following questions:

(i) (1) Why does the density of transition elements increase from Titanium to Copper? (at. no. Ti = 22, Cu = 29) **[4×2]**

(2) Why is zinc not regarded as a transition element?

(at. no. Zn = 30)

(ii) Identify the compounds A, B, C and D.

$$CH_3CN \xrightarrow{H_2O/H^+} A \xrightarrow{NH_3} B \xrightarrow{heat} C \xrightarrow{Br_2/KOH} D$$

(iii) Calculate the osmotic pressure of a solution prepared by dissolving 0·025g of K_2SO_4 in 2·0 litres of water at 25°C assuming that K_2SO_4 is completely dissociated. (mol. wt. of K_2SO_4 = 174 g mol^{-1})

(iv) What type of isomerism is shown by the following coordination compounds:

[Pt Cl_2 $(NH_3)_4$)] Br_2 and [Pt $Br_2(NH_3)_4$] Cl_2.

Write their IUPAC names.

Comments of Examiners

(a) (i) Some candidates filled *electrical* and *chemical* in the blank instead of *chemical* and *electrical*.

(ii) Many candidates wrote *68%* and *74%* instead of *32%* and *26%.*

(iii) A few candidates wrote *white* precipitate instead of yellow precipitate and *Lucas* test instead of *iodoform* test.

(iv) Some candidates wrote *tetrahedral* instead of *square pyramidal* in the first blank while a few candidates wrote d^2sp^3 instead of sp^3d^2 in the second blank.

(b) (i) Some of the candidates wrote *carbonation* instead of *a carbocation*.

(ii) Instead of *Hoope's process*, some candidates gave incorrect options such as *Baeyer's process or Hall's process.*

(iii) Instead of *373.0512* K a few candidates wrote *373.512* K or *373.065* K which was not correct.

(iv) Many candidates wrote the *formation of carbocation or elimination of water* instead of *protonation of alcohol molecule.*

(c) Most of the candidates gave correct answers. In a few cases, *purification of colloids* was matched with *glycine* and *zwitterion* with *dialysis*.

(d) (i) (1) Most of the candidate did not write the correct explanation for increase of the density of transition elements. Their explanation was in terms of increase in atomic number instead of increase in nuclear change.

(2) The reason for zinc not being regarded as a transition element was not written properly by majority of the candidates.

(ii) Most of the candidates identified compounds A, B, C and D correctly but some candidates failed to identify B as CH_3COONH_4.

(iii) The value of osmotic pressure was not calculated correctly by most of the candidates. Van't Hoff factor was not considered, hence the answer obtained was one-third of the correct answer.

(iv) The type of isomerism was correctly identified by most candidates, but many could not write the correct nomenclature of the compounds.

Suggestions for teachers

- Explain electrochemical cell and its working thoroughly.
- Discuss different types of unit cells and their packing in detail.
- Give adequate practice for different tests based on organic reactions.
- Explain the geometry and hybridization of compounds with examples.
- Explain the mechanism of organic reactions in a stepwise manner.
- Ask the students to learn colligative properties in detail.
- Interpret topics such as biodegradable, polymers, biomolecules, surface chemistry and chemical kinetics in detail.
- Ask students to learn periodic properties of transition elements.
- Give more practice in conversion of organic compounds. Every step of the conversion must be shown with proper conditions.
- Point out the importance of Van't Hoff factor while teaching abnormal molecular weight.
- Clarify isomers and isomerism of coordination compounds with examples.
- Explain rules of nomenclature with emphasis on correct spelling.

MARKING SCHEME

Question 1

(a)				
	(i)	Chemical, electrical		
	(ii)	32, 26		
	(iii)	Yellow, iodoform		
	(iv)	Square pyramidal, sp^3d^2		
(b)				
	(i)	1 or a carbocation		
	(ii)	2 or Hoope's process		
	(iii)	4 or 373·0512 K		
	(iv)	3 or Protonation of alcohol molecule		
(c)				
	(i)	Rate constant	(c)	Arrhenius equation
	(ii)	Biodegradable polymer	(d)	PHBV
	(iii)	Zwitter ion	(b)	Glycine
	(iv)	Purification of colloids	(a)	Dialysis

(d)

(i) (1) On moving from Ti to Cu, the atomic radii decrease due to increase in nuclear charge. Therefore, atomic volume decreases with increase in atomic mass. Hence, density increases.

(2) Zn has completely filled d-orbitals in its atomic as well as in its common oxidation state. (Zn^{+2}) OR d^{10} configuration.

(ii)

$$CH_3 - C \equiv N \xrightarrow{H_3O^+} \underset{[A]}{CH_3COOH} \xrightarrow{NH_3} \underset{[B]}{CH_3COONH_4} \xrightarrow{heat} \underset{[C]}{CH_3CONH_2} \xrightarrow[KOH]{Br_2} \underset{[D]}{CH_3NH_2}$$

or

[A] CH_3COOH/ Acetic Acid

[B] CH_3COONH_4/ Ammonium Acetate

[C] CH_3CONH_2/ Acetamide / Ethanamide

[D] CH_3NH_2 / Methyl Amine

(iii)

$$\pi = i\ CRT \ \ or\ i\frac{n}{V}RT \ \ or\ i\frac{w}{mV}RT$$

$$= \frac{3\times0\cdot025}{174\times2} \times 0\cdot0821 \times 298$$

$$= 5\cdot2728 \times 10^{-3} \text{atm}$$

	(iv)	Isomerism - Ionisation Isomerism IUPAC names - tetraamminedichloridoplatinum(IV) bromide and tetraamminedibromidoplatinum(IV) chloride

Question 2

[2]

(a) (i) Write the rate law expression for the reaction A + B + C → D + E, if the order of reaction is first, second and zero with respect to A, B and C, respectively.

(ii) How many times the rate of reaction will increase if the concentration of A, B and C are doubled in the equation given in (i) above?

OR

(b) The rate of reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature. ($R = 8{\cdot}314\ J\ K^{-1}\ mol^{-1}$)

Comments of Examiners

(a) (i) Rate Law expression for the reaction A+ B+ C→ D+E was answered correctly by many candidates. However, some candidates gave the expression as: rate = $[A]^1[B]^2[C]^\circ$ or rate $\propto K[A]^1[B]^2[C]^\circ$, which was incorrect.

(ii) The increase in the rate of reaction was calculated correctly by most of the candidates.

(b) Some candidates used incorrect formula while a few others wrote wrong value of 'R'. Instead of writing $R = 8.314\ J\ K^{-1}\ mol^{-1}$ they wrote R=0.0821. Some candidates could not write the correct unit along with the answer.

Suggestions for teachers

- Explain the Rate Law expression with examples. Also give adequate practise for different order reactions.
- Make the relationship between change in concentration and rate of reaction for different order reactions clear to the students.
- Teach how Arrhenius equation is used to calculate the energy of activation (E_a) by using rate constant method.

MARKING SCHEME

Question 2

(a)	(i)	Rate law expression Rate = $k\ [A]^1\ [B]^2\ [C]^0$ **OR** Rate = $k\ [A]^1\ [B]^2$
	(ii)	Rate of reaction will increase 8 times if the concentration of A, B and C are doubled.
	OR	
(b)	$T_1 = 293$ K $T_2 = 313$ K $K_2 / K_1 = 4$ $R = 8{\cdot}314\ J\ K^{-1}\ mole^{-1}$	

	$\text{Log}\frac{K_2}{K_1} = \frac{Ea}{2{\cdot}303R}\left(\frac{T_2-T_1}{T_1T_2}\right)$ $\text{Log } 4 = \frac{Ea}{2{\cdot}303\times8{\cdot}314}\left(\frac{313-293}{293\times313}\right)$ $0{\cdot}6021 = \frac{Ea}{19{\cdot}147}\left(\frac{20}{91709}\right)$ = 52862·94 J / mol or 52·863 kJ / mol

Question 3

[2]

(a) How do antiseptics differ from disinfectants?

(b) State the role of the following chemicals in the food industry:

(i) Sodium benzoate

(ii) Aspartame

Comments of Examiners

(a) The difference between antiseptics and disinfectants was not brought out clearly by most of the candidates. Also, the examples given by many candidates were not correct.

(b) (i) A few candidates could not write the role of Sodium benzoate in the food industry.

(ii) For *aspartame*, some candidates wrote that it is used as a *flavouring agent* instead of *an artificial sweetening agent.*

Suggestions for teachers

- Encourage students to read the Unit: **Chemistry in Everyday life**. The use of chemicals in medicine should be illustrated to the students with suitable examples.
- Discuss the use of various chemicals in the food industry with suitable examples.

MARKING SCHEME

Question 3

(a)	Antiseptics		Disinfectants	
	(i)	These chemicals prevent the growth of micro-organism or may even kill them without affecting the living tissues.	(i)	These chemicals destroy the microorganism but are harmful for living tissues.
	(ii)	They are applied to living tissues such as ulcers, wounds, diseased stem surface.	(ii)	They are generally used to kill microorganisms and are applied to inanimate objects like floor, toilets.
		(Any one difference for each. An example will not be accepted as a difference.)		
(b)	(i)	Sodium benzoate: Food preservative		
	(ii)	Aspartame: artificial sweetening agent		

[2]

Question 4

An aromatic organic compound [A] on heating with NH_3 and Cu_2O at high pressure gives [B]. The compound [B] on treatment with ice cold solution of $NaNO_2$ and HCl gives [C], which on heating with Cu/HCl gives compound [A] again. Identify the compounds [A], [B] and [C]. Write the name of the reaction for the conversion of [B] to [C].

Comments of Examiners

Compounds (A) (B) and (C) were identified correctly by most of the candidates. A few candidates wrote (A) as benzene instead of chlorobenzene and (C) as chlorobenzene instead of benzenediazonium chloride. Some candidates wrote the name of the reaction as Sandmeyer's reaction instead of Diazotisation reaction.

Suggestions for teachers

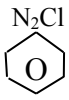
- Give ample practice for conversion of Organic compounds.
- Teach named organic reactions with proper conditions.

MARKING SCHEME

Question 4

(A)  Or C_6H_5Cl or Chlorobenzene

(B)  Or $C_6H_5NH_2$ or Aniline

(C)  Or $C_6H_5N_2Cl$ or Benzenediazonium chloride
Diazotisation reaction

Question 5

[2]

Write the names of the monomers for each of the following polymers:

(a) Bakelite

(b) Nylon – 2 – nylon – 6

Comments of Examiners

(a) The monomers of bakelite were named correctly by most candidates. A few candidates wrote *benzene* instead of *phenol* and *acetaldehyde* instead of *formaldehyde*.

(b) Monomers of Nylon – 2 – nylon - 6 were not written correctly by most of candidates. Many candidates wrote monomers of Nylon 6 (i.e. caprolactum) or monomers of nylon 6, 6 (i.e. ethylene diamine and adipic acid) instead of monomers of Nylon - 2 nylon - 6 (i.e. glycine and 5-aminocaproic acid).

Suggestions for teachers

- Teach the correct pair of monomers to students. Give practice in writing names and structures of monomers and units of polymers.
- Elucidate biodegradable and non-biodegradable polymers in class in detail.

MARKING SCHEME Question 5	
(a)	Bakelite: phenol and formaldehyde
(b)	Nylon – 2 – nylon – 6: glycine and 5 – aminocaproic acid

Question 6

[2]

Name the purine bases and pyrimidine bases present in RNA and DNA.

Comments of Examiners

Many candidates did not specify the purine and the pyrimidine bases of DNA and RNA. They combined and wrote all the bases.

Suggestions for teachers

Teach structure of RNA and DNA with proper purines and pyrimidine bases along with diagrams.

MARKING SCHEME Question 6		
	DNA	RNA
Purine bases	Adenine and guanine	Adenine and guanine
Pyrimidine bases	Thymine and cytosine	Uracil and cytosine

Question 7

[2]

(a) How will you obtain the following? (Give balanced equation.)

(i) Picric acid from phenol.

(ii) Ethyl chloride from diethyl ether.

OR

(b) How will you obtain the following? (Give balanced equation.)

(i) Anisole from phenol

(ii) Ethyl acetate from ethanol.

Comments of Examiners

(a)(i)Most of the candidates wrote unbalanced equations. A few of them did not write concentrated HNO_3 or concentrated H_2SO_4. Some candidates did not write the by-product i.e. H_2O for the conversion of phenol to picric acid.

(ii) For the conversion of C_2H_5-O-C_2H_5 to C_2H_5Cl, some candidates used Cl_2 instead of PCl_5 or $SOCl_2$. A few candidates did not write the by product.

(b) (i) For the conversion of phenol to anisole, many candidates converted phenol directly by reacting with CH_3Br. They did not convert phenol to phenoxide.

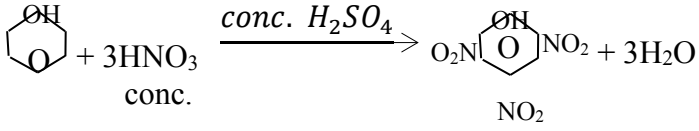
(ii) For the conversion of ethanol to ethyl acetate, most of the candidates wrote incorrect structure of the product. Some candidates did not balance the equation.

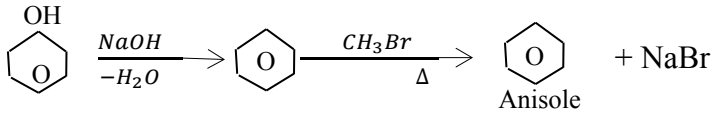
Suggestions for teachers

- Explain organic reactions and conversions with proper reactants, catalysts and conditions.
- More practice should be given for the conversion of organic compounds with balanced equations.
- Explain to the students to write the by product in all organic reactions.

MARKING SCHEME

Question 7

(a)	(i)	
	(ii)	$C_2H_5OC_2H_5 + PCl_5 \rightarrow 2C_2H_5Cl + POCl_3$ **or** $C_2H_5OC_2H_5 + SOCl_2 \rightarrow 2C_2H_5Cl + SO_2$

		OR ONa OCH$_3$
(b)	(i)	 + NaBr
	(ii)	$C_2H_5OH + CH_3COOH \xrightarrow[H_2SO_4]{conc} CH_3COOC_2H_5 + H_2O$ **Or** $C_2H_5OH + CH_3COCl \rightarrow CH_3COOC_2H_5 + HCl$ **Or** $C_2H_5OH + (CH_3CO)_2O \rightarrow CH_3COOC_2H_5 + CH_3COOH$

Question 8

[2]

40% of a first order reaction is completed in 50 minutes. How much time will it take for the completion of 80% of this reaction?

Comments of Examiners

Most of the candidates calculated the answer by using the unitary method instead of using the appropriate formula. Some candidates substituted the value of (a-x) as 40 instead of 60. Some candidates reported the time in seconds which was not required.

Suggestions for teacher

- Give more practice in numerical problems based on order reaction. Emphasise on step by step calculations to calculate the value of k and t.
- Train students to solve problems in a step by step manner: formula →substitution→ calculation→ answer with unit.

MARKING SCHEME

Question 8

$k = \frac{2{\cdot}303}{t} \log_{10} \frac{a}{a-x}$

$= \frac{2{\cdot}303}{50} \log \frac{100}{60}$

$k = \frac{2{\cdot}303}{50} \times 0 \cdot 2218$

$k = 0{\cdot}0102\ min^{-1}$

$t = \frac{2{\cdot}303}{k} \log \frac{100}{20}$

$t = \frac{2{\cdot}303}{0{\cdot}0102} \times 0 \cdot 6989$

$t = 157{\cdot}8\ min$

[3]

Question 9

(a) The freezing point of a solution containing 5·85g of NaCl in 100 g of water is −3·348 °C. Calculate van't Hoff factor 'i' for this solution.What will be the experimental molecular weight of NaCl?

(K_f for water = 1·86 K kg mol^{-1}, at. wt. Na = 23, Cl = 35·5)

OR

(b) An aqueous solution containing 12·48g of barium chloride ($BaCl_2$) in 1000 g of water, boils at 100·0832°C. Calculate the degree of dissociation of barium chloride. (K_b for water = 0·52 K kg mol^{-1}, at. wt. Ba = 137, Cl = 35·5)

Comments of Examiners

(a) Most candidates calculated the value of van't Hoff factor (i) correctly but some failed to calculate the value of experimental molecular weight of NaCl.

(b) Most of the candidates calculated the correct value of van't Hoff factor (i) but they were not able to calculate the number of particles formed after ionisation of $BaCl_2$ i.e.

$BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$, n=3

They were not able to substitute the value of 'n' correctly in the formula, hence, degree of dissociation of $BaCl_2$ was not calculated correctly.

Suggestions for teachers

- Teach abnormal molecular weight, using van't Hoff factor (i) along with degree of dissociation/ association comprehensively to the students.
- Give more practice in numerical problems based on van't Hoff factor.

MARKING SCHEME

Question 9

(a)	$\Delta T_f = i\,K_f \times m$ Or $\Delta T_f = i\,K_f \times \frac{w_B \times 1000}{m_B \times w_A}$ $3{\cdot}348 = i \times 1{\cdot}86 \times \frac{5{\cdot}85 \times 1000}{58{\cdot}5 \times 100}$ $\therefore i = \frac{3{\cdot}348}{1{\cdot}86} = 1{\cdot}8$ $i = \frac{normal\ molecular\ weight}{experimental\ molecular\ weight}$ $\therefore Experimental\ molecular\ weight = \frac{normal\ molecular\ weight}{i}$ or $= \frac{58{\cdot}5}{1{\cdot}8}$ $= 32{\cdot}5$ g mol^{-1}
	OR
(b)	w_2 = 12·48 g, T_s = 100·0832°C w_1 = 1000 g, K_b for water = 0·52 K mol^{-1} M_2 ($BaCl_2$) = 208

	$\Delta T_b = T_s - T_o$ $= 100{\cdot}0832 - 100$ $= 0{\cdot}0832^oC$ $M_2 = \frac{1000\,K_b w_2}{\Delta T_b \times w_1}$ $= \frac{1000 \times {\cdot}52 \times 12{\cdot}48}{0{\cdot}0832 \times 1000}$ $= 78 g\ mol^{-1}$ $i = \frac{normal\ molecular\ weight}{observed\ molecular\ weight}$ $= \frac{208}{78}$ $= 2{\cdot}666$ or $2{\cdot}67$ $BaCl_2 \rightarrow Ba^{+2} + 2Cl^-$ (3 ions) $\alpha = \frac{i-1}{n-1} = \frac{2{\cdot}67-1}{3-1} = \frac{1{\cdot}67}{2} = 0 \cdot 835$ **or** 83·5%

Question 10

[3]

Examine the defective crystal given below and answer the question that follows:

A^+	B^-	A^+	B^-	A^+
B^-		B^-	A^+	B^-
A^+	B^-	A^+		A^+
B^-	A^+	B^-	A^+	B^-

State if the above defect is stoichiometric or non-stoichiometric. How does this defect affect the density of the crystal? Also, write the term used for this type of defect.

Comments of Examiners

Most of the candidates were able to answer this part correctly. Some candidates wrote *non- stoichiometric* instead of *stoichiometric defect*. The density of crystal should decrease but some candidates wrote that there would be no change in density. The term used for this type of defect was Schottky defect, but some candidates wrote it as Frenkel defect.

Suggestions for teachers

Explain various types of imperfections in solids to students. Also discuss how these imperfections affect the properties of the crystal.

MARKING SCHEME Question 10	
	The defect is stoichiometric (because equal number of cations and anions are missing from lattice sites.)
	It lowers the density of the crystal.
	Schottky Defect.

Question 11

[3]

Give reason for each of the following:

(a) For ferric hydroxide sol the coagulating power of phosphate ion is more than chloride ion.

(b) Medicines are more effective in their colloidal form.

(c) Gelatin is added to ice creams.

Comments of Examiners

(a) Most of the candidates did not write the correct reason. Many did not use Hardy Schulze law to explain the answer.

(b) Many candidates gave incorrect reason regarding effectiveness of medicines in their colloidal form.

(c) This part was also answered incorrectly by many candidates. Quite a few wrote that it acts as a flavouring or a sweetening agent.

Suggestions for teachers

- Familiarise students with different laws/ principles/ key concepts and their applications thoroughly, especially those which are useful in our daily lives.
- Give more practice to students in answering reasoning type questions.

MARKING SCHEME Question 11	
(a)	According to Hardy-Schulze law, phosphate ion has more negative charge as compared to chloride ion.
(b)	Assimilation is easy due to their colloidal size.
(c)	Gelatin when added to ice creams acts as an emulsifier and helps to stabilise the emulsion. (Protective colloid).

Question 12

[3]

(a) For the complex ion $[Fe(CN)_6]^{3-}$, state:

(i) the type of hybridisation.

(ii) the magnetic behaviour.

(iii) the oxidation number of the central metal atom.

(b) Write the IUPAC name of $[Co(en)_2Cl_2]^+$ ion and draw the structures of its geometrical isomers.

Comments of Examiners

(a) For the complex ion $[Fe(CN)_6]^{3-}$:

(i) the type of hybridisation was d^2sp^3 but some candidates wrote sp^3d^2 hybridization.

(ii) the magnetic behaviour of $[Fe(CN)_6]^{3-}$ was paramagnetic but a few candidates wrote *diamagnetic behavior*.

(iii) many candidates wrote oxidation state of central metal as +6 or -3 instead of +3.

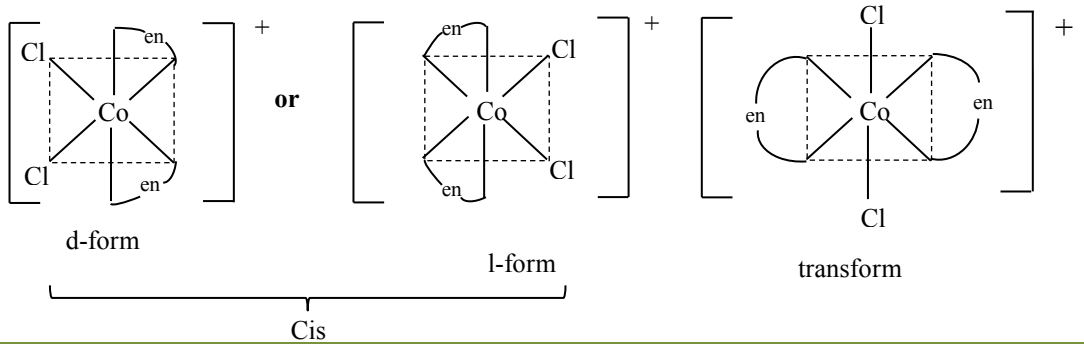
(b) Most of the candidates were unable to write the correct IUPAC name of the complex compound. They did not write the correct alphabetic order in case of name of Ligands. Oxidation number of central metal atom was not calculated correctly. Most of the candidates were unable to draw the structures of geometrical isomers.

Suggestions for teachers

- Explain the method to determine the type of hybridization, magnetic behaviour and Oxidation state, by using valence bond theory.
- Discuss strong field, weak field, ligands, low spin complexes and high spin complexes with magnetic behaviour with students.
- Teach the rules of nomenclature of coordination compounds in detail and give adequate practice. Explain Geometrical isomers with examples.

MARKING SCHEME

Question 12

(a)	(i)	d^2sp^3
	(ii)	Paramagnetic
	(iii)	+3
(b)	dichloridobis(ethylenediamine) cobalt (III) ion  d-form l-form Cis transform

Question 13

[3]

(a) Explain why:

(i) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.

(At. no. of Mn = 25, Fe = 26)

(ii) Transition elements usually form coloured ions.

(iii) Zr and Hf exhibit similar properties.

(At. no. of Zr = 40, Hf = 72)

OR

(b) Complete and balance the following chemical equations:

(i) $KMnO_4 + KI + H_2SO_4 \rightarrow$ _____ + _____ + _____ + _____

(ii) $K_2Cr_2O_7 + H_2SO_4 + H_2S \rightarrow$ _____ + _____ + _____ + _____

(iii) $KMnO_4 + H_2SO_4 + FeSO_4 \rightarrow$ _____ + _____ + _____ + _____

Comments of Examiners

(a) (i) Many candidates wrote only the electronic configuration of Mn^{2+} and Fe^{2+} but they could not explain the reason for the stability of Mn^{2+} towards oxidation to + 3 state.

(ii) Some candidates explained that formation of coloured ions of transition elements was due to vacant 'd' orbital or partially filled 'd' orbital which was incorrect.

(iii) Most candidates were not able to give the reason for Zr and Hf exhibiting similar properties.

(b) Unbalanced/ partially balanced/ incorrect equations were given by many candidates. Some candidates wrote incorrect formulae of products such as $Mn(SO_4)_2$ instead of $MnSO_4$, $Cr(SO_4)_3$ instead of $Cr_2(SO_4)_3$ and Fe_2SO_4 instead of $Fe(SO_4)_3$.

Suggestions for teachers

- Explain properties of d Block elements in detail with the help of Orbital diagrams and suitable examples. Keywords such as d-d transition, half-filled sub shells, stability, etc. must be explained. Also explain Lanthanide contraction and its consequences.
- Give more practice in writing complete and correctly balanced chemical equations. Student should be explained the oxidising and reducing properties of $K_2 Cr_2 CO_7$ and KMn O_4

MARKING SCHEME

Question 13

(a)	(i)	Electronic configuration of Mn^{+2} is $3d^5$, which is half filled and hence stable. Hence, it cannot lose third electron easily. In case of Fe^{+2} electronic configuration is $3d^6$. Hence,it can lose one electron easily to give stable configuration $3d^5$.
	(ii)	It is due to d – d transition by absorbing part of visible light.

	(iii)	Due to Lanthanoid contraction they have same atomic and ionic size. **or** They have same general electronic configuration.
	OR	
(b)	(i)	$2KMnO_4 + 10KI + 8H_2SO_4 \rightarrow 6K_2SO_4 + 2MnSO_4 + 5I_2 + 8H_2O$
	(ii)	$K_2Cr_2O_7 + 4H_2SO_4 + 3H_2S \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3S + 7H_2O$
	(iii)	$2KMnO_4 + 8H_2SO_4 + 10FeSO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

Question 14

[3]

(a) Arrange the following in the increasing order of their basic strength:

$C_2H_5NH_2$, $C_6H_5NH_2$, $(C_2H_5)_2NH$

(b) Give a balanced chemical equation to convert methyl cyanide to ethyl alcohol.

(c) What happens when benzene diazonium chloride reacts with phenol in weak alkaline medium? (Give balanced equation).

Comments of Examiners

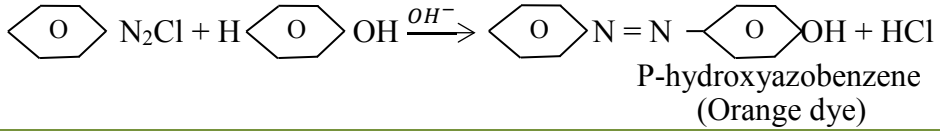
(a) Instead of writing in increasing order of basic strength, a few candidates wrote the answer in decreasing order. Some candidates wrote incorrect order such as $C_2H_5NH_2 < C_6H_5NH_2 < (C_2H_5)_2NH$ instead of $C_6H_5NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$.

(b)Many candidates converted methyl cyanide to acetic acid or methyl cyanide to ethyl amine instead of methyl cyanide to ethyl alcohol. Many candidates did not write the by-product.

(c) The reaction of benzene diazonium chloride with phenol in weak alkaline medium was not written by many candidates. Some candidates were neither able to write the correct product nor able to write the colour of the dye. Only a few could write the correct balanced equation.

Suggestions for teachers

- Explain clearly giving reasons how the basic strength of amines increases or decreases.
- Insist upon learning conversion of one organic compound to other and give ample practice in writing balanced chemical equations with proper conditions/reagents.
- Instruct students to read the observations of different organic reactions with colour or precipitate. Diazotisation, formation of azo dye should be explained properly to students.

MARKING SCHEME	
Question 14	
(a)	The increasing order of basic strength given organic compounds: $C_6H_5NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$
(b)	$CH_3 - C \equiv N \xrightarrow[\text{or } Na/C_2H_5OH]{4[H]/LiAlH_4} CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH + N_2 + H_2O$ Or $CH_3 - C \equiv N + 2H_2 \xrightarrow{Ni \text{ or } Pt} CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH + N_2 \uparrow + H_2O$
(c)	 P-hydroxyazobenzene (Orange dye)

[3]

Question 15

Name the sulphide ore of Copper. Describe how pure copper is extracted from this ore.

Comments of Examiners

Name of copper ore was mentioned correctly by most of the candidates. However, extraction of copper from the sulphide ore was not given stepwise by many candidates. Quite a few wrote the name of process such as Roasting, Smelting, Bessemerisation without giving the details and the chemical equation/s involved. Some forgot to write "electro refining".

Suggestions for teachers

- Advise students to learn metallurgy in detail.
- Explain principles and process of isolation of metals with the help of flowcharts.
- Interpret the extraction of metal with proper steps like concentration, roasting, smelting, etc. with complete balanced equations involved. The process of refining should also be illustrated completely.

MARKING SCHEME Question 15	
	The sulphide ore of copper is: Chalcopyrite / copper pyrite / $CuFeS_2$
	Extraction of pure copper from its ore:
	Froth flotation process
	Roasting – concentrated ore is heated with excess of air or oxygen. $2CuFeS_2 + O_2 \rightarrow Cu_2S + 2FeS + SO_2\uparrow$
	Smelting – Roasted ore is mixed with coke and sand and fed into the blast furnace. $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ $2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$ $FeO + SiO_2 \rightarrow FeSiO_3$ Auto reduction takes place in Bessemer Converter or Bessemerisation $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2\uparrow$ Blister Copper Electrorefining gives pure Cu (99·9%) (*either equation or statement*)

Question 16

[5]

(a) (i) Calculate the emf and ΔG^o for the cell reaction at 25°C:

$Zn(s)|Zn^{2+}_{(aq)}||Cd^{2+}_{(aq)}|Cd_{(s)}$

(0·1M) (0·01M)

Given $E^oZn^{2+}/Zn = -0 \cdot 763$ *and* $E^oCd^{2+}/Cd = -0 \cdot 403\ V$

(ii) Define the following terms:

(1) Equivalent conductivity

(2) Corrosion of metals

OR

(b) (i) The specific conductivity of a solution containing 5 g of anhydrous $BaCl_2$ (mol. wt. = 208) in 1000 cm^3 of a solution is found to be 0·0058 $ohm^{-1}cm^{-1}$. Calculate the molar and equivalent conductivity of the solution.

(ii) What is an electrochemical series? How is it useful in predicting whether a metal can liberate hydrogen from acid or not?

Comments of Examiners

(a) (i) A few candidates calculated the value of $E°_{cell}$ with negative sign i.e. - 0.36 V instead of +0. 36 V. Many candidates wrote incorrect formula for Nernst equation. Instead of calculating $\Delta G°$, some candidates calculated ΔG which was not asked.

(ii) (1) Many candidates wrote incorrect definition of *equivalent conductivity* or wrote an incorrect formula and its relationship with specific conductance.

(2) Some candidates wrote the definition of *rusting* instead of *corrosion of metals.*

(b) (i) The values of molar conductivity and equivalent conductivity of the solution were calculated correctly but the answer with correct unit was not given by most of the candidates.

(ii)Most candidates wrote the definition of *metal activity series* instead of *electrochemical series.* Some candidates wrote that metals above hydrogen can liberate hydrogen gas from acid. They did not write the answer in terms of reduction potential value.

Suggestions for teachers

- Give adequate practise in solving numerical problems based on Nernst equations
- Explain the relationship between Gibbs free energy, $\Delta G°$, $E°_{cell}$ and differences between $\Delta G°$ and ΔG clearly.
- Teach definitions of equivalent conductivity and corrosion of metal to the students. Also explain the related key concepts like factors affecting corrosion and prevention of corrosion.
- Give practice in numerical problems based on specific conductance, molar conductance and equivalent conductance.
- Instruct students to define electrochemical series in term of standard reduction potential values of elements.

MARKING SCHEME

Question 16

(a)	(i)	$E^0_{cell} = E^0_{cathode} - E^0_{anode}$ $= -0{\cdot}403 - (-0{\cdot}763)$ $= 0{\cdot}36$ V $E_{cell} = E^0_{cell} - \frac{0\cdot0591}{n}\log\frac{[Zn^{+2}]}{[Cd^{+2}]}$ **Or** $E_{cell} = 0{\cdot}36 - \frac{0{\cdot}0591}{2}\log\frac{0{\cdot}1}{0{\cdot}01}$

		E_{cell} =0·36 − 0·0295 log 10 = 0·36 − 0·0295 ×1 = 0·3305 V $\Delta G^0 = -n\,F\,E^0$ $= -2 \times 96{,}500 \times 0 \cdot 36$ $= -69480$ J /mol $= -69 \cdot 48$ kJ/mol	
	(ii)	(1)	Equivalent Conductivity of Electrolyte – is the conducting power of all the ions produced by dissolving one-gram equivalent in V cc. of solution.
		(2)	Corrosion of metals– The slow and spontaneous process of the conversion of a metal into an undesirable compound (usually oxide) on exposure to atmospheric conditions is called corrosion of metals.

OR

Molarity of $BaCl_2 = \frac{Strength\ of\ BaCl_2}{Molecular\ weight} = \frac{5}{208} = 0 \cdot 024\ M$

Molar conductivity $(\wedge m) = specific\ conductivity \times \frac{1000}{molarity}$

Molar conductivity $(\wedge m) = \frac{0{\cdot}0058 \times 1000}{Molarity}$

or

Molar conductivity $(\wedge m) = \frac{0{\cdot}0058 \times 1000}{0{\cdot}024}$

= 241·67 $ohm^{-1}\ cm^2\ mol^{-1}$

Equivalent weight of $BaCl_2 = \frac{208}{2} = 104$

Normality of $BaCl_2 = \frac{5}{104} = \cdot\ 048\ N$

Equivalent conductivity$(\wedge_{eq}) = \frac{specific\ conductivity \times 1000}{Normality}$

Or

$$\wedge_{eq} = \frac{0 \cdot 0058 \times 1000}{0 \cdot 048}$$

$\wedge_{eq} = 120 \cdot 83\ ohm^{-1}\ cm^2\ eq^{-1}$

When various electrode systems are arranged in the order of their E^o values, the series obtained is called electrochemical series. Elements having negative value of E^o will liberate H_2 from acids.

(or any correct definition)

Question 17

[5]

(a) (i) Explain why:

(1) Nitrogen does not form pentahalides.

(2) Helium is used for filling weather balloons.

(3) ICl is more reactive than I_2.

(ii) Draw the structures of the following:

(1) $HClO_4$

(2) H_3PO_3

OR

(b) (i) Explain why:

(1) Mercury loses its meniscus in contact with ozone.

(2) Halogens are coloured and the colour deepens on moving down in the group from fluorine to iodine.

(3) Hydride of sulphur is a gas while hydride of oxygen is a liquid.

(ii) Complete and balance the following reactions:

(1) $NaCl + MnO_2 + H_2SO_4 \rightarrow$ _____ + _____ + _____ + _____

(2) $KMnO_4 + SO_2 + H_2O \rightarrow$ _____ + _____ + _____

Comments of Examiners

(a)(i) (1) Most of the candidates did not mention the absence of d orbital in nitrogen.

(2) Some candidates wrote that Helium is a noble gas but did not write that it is light, inert and non-inflammable.

(3) Many candidates wrote that chlorine is more electronegative, but they did not mention that I-Cl bond is weaker than I-I Bond.

(ii) (1) Many candidates drew correct structure of $HClO_4$ but a few showed the bond between H and Cl instead of H and O(oxygen), which was not correct.

(2) Many candidates drew incorrect structure - they showed three bonds between -OH and P (phosphorus).

(b)(i) (1) Mercury losses it meniscus due to tailing of Mercury or formation of mercurous oxide - this was not specified by most of the candidates.

(2) The absorption of light in visible region depends upon size of halogen atoms - this fact was not reported by many candidates.

Suggestions for teachers

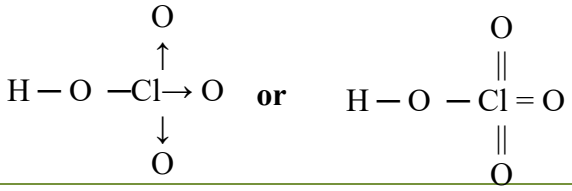
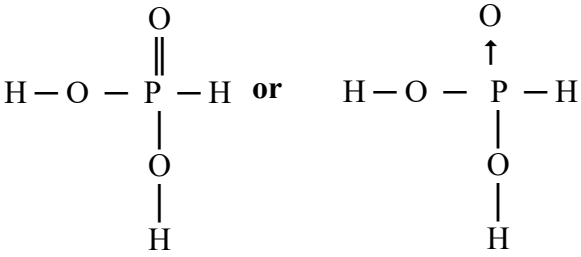
- Explain the electronic configuration and properties of p-block elements with reasons for variable valency.
- Explain property of noble gases in detail.
- Guide students that inter halogen compounds are more reactive due to differences in electronegativity of atoms. They have low bond dissociation energy hence, more reactive.
- Show structure of oxyacids of halogens, sulphur and phosphorus in class.
- Teach characteristic properties of p- block elements in detail.
- Instruct students to write complete and balanced equations giving names of the reactant/s and product/s.

(3) Some candidates did not explain the answer in terms of intermolecular hydrogen bonding.

(ii) Many candidates wrote incomplete/incorrect or unbalanced equations.

MARKING SCHEME

Question 17

(a)	(i)	(1)	Due to the absence of d-orbitals in its valence shell, nitrogen does not form pentahalides.
		(2)	Helium being inert, non-inflammable and light gas is used in filling weather balloons.
		(3)	I –Cl bond is weaker than I – I bond. I – Cl bond breaks easily to form halogen atoms (I and Cl)
	(ii)	(1)	$HClO_4$  **or**
		(2)	H_3PO_3  **or**
	OR		
(b)	(i)	(1)	Mercury in presence of ozone is oxidised to sub oxide (Mercurous oxide) which dissolves in mercury. It starts sticking to glass and loses meniscus (Tailing of Hg). **Or** $2Hg + O_3 \rightarrow Hg_2O + O_2$
		(2)	Halogens are coloured due to absorption of light in visible region. Fluorine being small absorbs violet colour and shows the complementary colour yellow whereas iodine absorbs yellow colour and shows complementary colour violet.
		(3)	Due to small size of oxygen atom H_2O forms intermolecular H-bond and gets associated hence occurs as liquid. While H_2S is simple covalent compound hence occurs as a gas.
	(ii)	(1)	$2NaCl + MnO_2 + 3H_2SO_4 \rightarrow 2NaHSO_4 + MnSO_4 + Cl_2 + 2H_2O$ **OR** $2NaCl + MnO_2 + 2H_2SO_4 \rightarrow 2Na_2SO_4 + MnSO_4 + Cl_2 + 2H_2O$
		(2)	$2KMnO_4 + 5SO_2 + 2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$

Question 18

[5]

(a) (i) Give balanced equations for the following reactions:

(1) Benzaldehyde reacts with hydrazine.

(2) Acetic acid reacts with phosphorous pentachloride.

(3) Acetone reacts with sodium bisulphite.

(ii) Give one chemical test each to distinguish between the following pairs of compounds:

(1) Ethanol and acetic acid

(2) Acetaldehyde and benzaldehyde

OR

(b) (i) Write chemical equations to illustrate the following name reactions:

(1) Clemmensen's reduction

(2) Rosenmund's reduction

(3) HVZ reaction

(ii) Explain why:

(1) Acetaldehyde undergoes aldol condensation, but formaldehyde does not.

(2) Acetic acid is a weaker acid as compared to formic acid.

Comments of Examiners

(a)(i)(1) Many candidates wrote incorrect formulae of reactants and product.

(2) For the reaction of acetic acid with phosphorus pentachloride, most of the candidates gave correct equation.

(3) Some candidates did not write the correct formula of product for the reaction of acetone with sodium bisulphite.

(ii) (1) *Iodoform test* was mentioned for distinguishing ethanol from acetic acid but the observation was not written by many candidates. Some candidates mentioned *esterification test* to distinguish between ethanol and acetic acid, but this test is given by both the compounds.

(2) Some candidates wrote *Tollen's reagent test* to distinguish between acetaldehyde and benzaldehyde - this is given by both the compounds.

(b)(i) (1) A few candidates wrote unbalanced equations. Some wrote H_2 instead of [H]. Several candidates did not write Zn/Hg and concentrated HCl. Many candidates did not write the by-product.

(2) Many candidates wrote nascent hydrogen [H] instead of H_2 or did not write the catalyst.

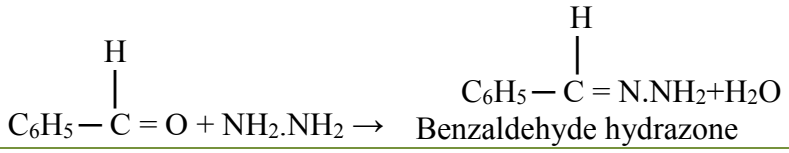
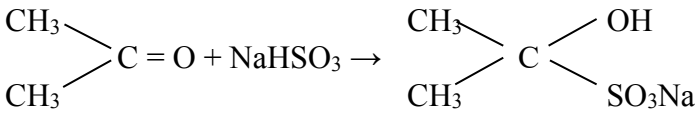
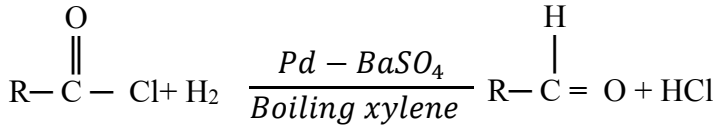
(3) Some candidates did not write the by product.

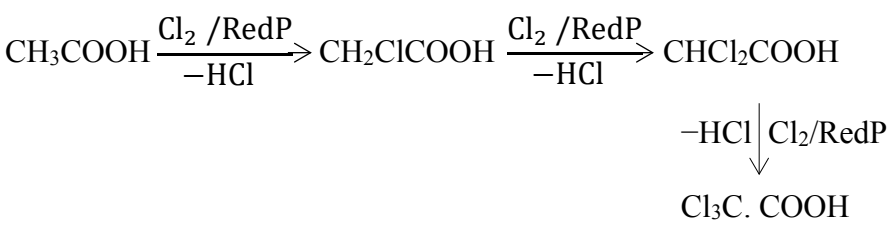
Suggestions for teachers

- Give sufficient practice in writing organic equations, with name of reactants, products and correct structure.
- Tell students that the given chemical test should be positive for one compound and negative for the other compound.
- Instruct students to learn the named organic reactions with the name of specific catalyst used in the reaction and other necessary conditions in the presence of which the required product/s is/are formed.
- Teach mechanism of Aldol condensation to clear the concept of the presence of α - H in CH_3CHO.
- Explain the strength of acid and base with the help of inductive effect.

MARKING SCHEME

Question 18

(a)	(i)	(1)	
		(2)	
		(3)	
	(ii)	(1)	Ethanol + I_2 + Alkali $\xrightarrow{\Delta}$ Yellow precipitate of Iodoform, acetic acid does not respond to this test. **or** Acetic acid + neutral $FeCl_3$ → Blood red coloration, Ethanol does not respond to this test. (*Or any other relevant test*)
		(2)	Acetaldehyde + I_2 + Alkali $\xrightarrow{\Delta}$ Yellow precipitate of Iodoform **Or** Acetaldehyde + Fehling solution $\xrightarrow{\Delta}$ Red precipitate of Cu_2O Benzaldehyde does not respond to the above test. (*Or any other relevant test*)
	OR		
(b)	(i)	(1)	Clemmensen's Reduction: $CH_3CHO + 4[H] \xrightarrow{Zn-Hg/HCl} CH_3CH_3 + H_2O$ **or** $CH_3COCH_3 + 4[H] \xrightarrow{Zn-Hg/HCl} CH_3CH_2CH_3 + H_2O$
		(2)	Rosenmund's Reduction: 

		(3)	HVZ reaction: 
	(ii)	(1)	Aldol condensation is given by aldehydes having α–hydrogen atom. Acetaldehyde has α –H but HCHO does not have α – hydrogen atom. Hence, does not give aldol condensation.
		(2)	Acetic acid has methyl (electron releasing) group which causes + I effect and decreases its acidic strength of acetic acid.

Note: For questions having more than one correct answer/solution, alternate correct answers/solutions, apart from those given in the marking scheme, have also been accepted.

GENERAL COMMENTS

Topics found difficult by candidates

- The packing efficiency of different type of unit cells. Imperfection in solids.
- Numerical problem based on elevation of boiling point, depression in freezing point,
- van't Hoff factor and degree of dissociation.
- Numerical problem related to Arrhenius equation.
- Rate Law expression order of reaction and half-life period.
- Nernst equation, electrochemical series, equivalent and molar conductance corrosion of metals.
- Surface chemistry, application of colloids, purification of colloids.
- Coordination compounds nomenclature, isomerism hybridisation of coordination compounds.
- Chemical equations of inorganic compounds, extraction of copper, chemical equations of $K_2 Cr_2 O_7$ and $KMnO_4$.
- Named organic reactions, conversion of organic compounds reasoning type of questions of organic chemistry.
- Polymers, Biodegradable Polymers and their examples.
- Use of chemicals in Food Industry, antiseptics and disinfectants.

Concepts in which candidates got confused

- Isomerism of coordination compounds (linkage and geometrical) and nomenclature of coordination compounds.
- Relationship between $E°_{cell}$ and standard free energy change ($\Delta G°$).
- Purines and pyrimidines present in RNA and DNA.
- Colloidal solution and their applications.
- Reactions of inorganic compounds with balanced equation.
- Tests to distinguish organic compounds.

Suggestions for candidates

- Be regular and systematic in your studies.
- Avoid selective study - questions are asked from every chapter.
- Name organic compounds preferably using the IUPAC Nomenclature.
- Always solve the numerical problems stepwise i.e., (a) formula (b) substitution (c) calculation (d) answer with correct unit.
- Practise adequate number of numerical problems.
- Always write balanced chemical equations with the essential conditions.
- Learn both positive and negative chemical tests of organic compounds.
- In each topic, learn the definitions with keywords with proper understanding. Write the keyword in your answer.
- Read the question paper carefully and understand what is required before attempting the question.
- Read the full chapter according to the topic given in the *scope of syllabus*.
- Do not waste time in attempting extra questions given as internal choice.
- Stress upon clarifying the concepts of each topic to answer the reasoning type of questions.